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Improving Risk Management Capability Using the Project Risk Maturity Model - a Case Study Based on UK Defence Procurement Projects

Martin Hopkinson

Introduction

Risk management has widely been considered to be an important project management process for more than two decades. However by modern scientific standards, it is difficult, if not impossible, to prove that the process adds value, owing to the nature of the experiment that would be required. In lieu of such proof, this paper offers quantitative evidence that supports the thesis that, if conducted to a sufficiently high standard, project risk management makes the outcome of projects more predictable. Knowledge of this evidence may encourage organisations to invest more time and effort in their project risk management process, particularly prior to key project go / no go decision points.

The evidence provided by this paper is based on project performance statistics for major defence equipment procurement projects owned by the UK Ministry of Defence (MoD). These statistics are drawn from six successive annual *MoD Major Projects* (MPR) *Reports* (2005 - 2010) produced by The UK's National Audit Office (NAO), disclosing project performance over the period April 2004 – March 2010. An analysis of these statistics has been used to assess the predictability of project outcomes relative to forecasts at the principle point of project approval: Main Gate. Trends in predictability can then be interpreted in the context of actions that the MoD took to improve its project risk management process.

Improvements in the MoD risk management process

NAO reports produced in the 1990s identified significant issues with the performance of the MoD's major equipment procurement projects. For example the 1997 MPR report noted an average project slip of 3 years post Main Gate and an overall cost escalation of £3billion. In response to these issues, starting from April 1999, the MoD started to implement its Smart procurement initiative. The Smart procurement approach included an increased focus on project risk management. First, all projects were expected to make greater investment in de-risking (up to 15% of the overall acquisition budget) prior to Main Gate. Second, as from the year 2000, all large projects seeking Main Gate approval were required to use quantitative cost and schedule risk modelling techniques to provide P10, P50 and P90 confidence forecasts.

However, by 2002, the MoD had recognised that its risk modelling had generally proved to be too optimistic; a disproportionate number of projects had started to exceed their risk-based confidence forecasts. Its response was to start a programme under which the risk management capability of its major projects was formally measured and improved. The tool used for this purpose was the Project Risk Maturity Model (RMM), developed by HVR and now owned (after its acquisition of HVR) by QinetiQ.

During the period April 2002 – March 2003, the Project RMM was used to assess the risk management capability of the cohort of projects included in the 2003 MPR report. Prioritised actions for improvement were identified for each project. A number of insights about the risk management process across the organisation were also identified. These insights included:

- The ability of projects to identify risks was usually better than their ability to analyse their implications. In most cases the quality of to cost and schedule risk modelling was not sufficient to produce realistic risk-based forecasts. This, in part, explained why risk-based forecasts had proved to be optimistic.

- Whilst projects were capable of planning effective risk responses, the most common cause of process weakness was a failure to implement responses. Since risk-based models used to support Main Gate approval were based on post-mitigation scenarios, this weakness also contributed to risk-based forecasts being too optimistic.

- Despite the fact that the organisation had provided clear practice guidance, different projects had different strengths and weaknesses. Many of the process issues thus involved process implementation rather than process design.

- The majority of major projects had a risk management capability of RMM Level 2. This was insufficient for the management of large and complex projects. A programme of improvement was thus required.

From April 2003 to March 2004, projects that had failed to achieve RMM Level 3 were re-assessed to verify that actions identified for improvement had been implemented. In most cases, they were and significant improvements were achieved.

In April 2004, the MoD introduced a new discipline under which entering the Main Gate approval process became conditional on the MoD project team being able to demonstrate that its risk management capability was sufficiently high for its risk-based forecasts to be credible. The aim of this discipline was to prevent the approval of projects with unrealistic confidence forecasts. The threshold used to enforce it was based on Project RMM assessments and is explained in more detail in the next section.

The Project Risk Maturity Model (RMM)

The Project RMM is a tool that can be used to assess a project's risk management capability. It was first developed by HVR Consulting Services in 1999 and has since been used for more than 300 project assessments. Lessons learned from these assessments have been used to refine the model, which has continued to evolve. The current version (v6.0) is available as a CD-ROM in a book *The Project Risk Maturity Model – measuring and improving risk management capability* (Hopkinson 2011).

The Project RMM assesses a project as being at one of four capability levels:

- Level 1 – Naïve
- Level 2 – Novice
- Level 3 – Normalised
- Level 4 – Natural

The definitions of these levels are derived from Hillson (1997) and detailed in Hopkinson (2011). However, for the purposes of this paper it should be noted that a project should be at RMM Level 4 in order for it to be able to produce realistic forecasts for the implications of overall project risk using Monte Carlo risk modelling techniques of the type used by MoD projects prior to Main Gate.

When, in April 2004, the MoD introduced a policy whereby any major project seeking Main Gate approval had demonstrate a minimum level of risk management capability, the standard required was set using the Project RMM. The threshold was defined as being RMM Level 3, combined with minimum requirements for five RMM criteria specifically related to risk modelling and estimating. Although this "Level 3 +" threshold was lower than RMM Level 4, it still represented a significant improvement on the typical level of risk management capability on projects. Since RMM assessments in 2002-3 had demonstrated that MoD major projects typically had a Level 2 capability, application of the new policy from April 2004, has made it meaningful to compare the post Main Gate performance of projects approved after this date with that of earlier projects.

Measures used to Compare Project Performance with Main Gate Forecasts

Two measures are used by this paper to compare the performance of MoD projects with their Main Gate Forecasts:

- Schedule slip (%)
- Schedule risk differential consumed

Schedule slip percentages are calculated relative to the Main Gate P50 forecast i.e.

$$\text{Project slip (\%)} = \frac{(P50_{C} - MG) \times 100}{P50_{MG} - MG}$$

MG is the date of Main Gate approval, $P50_{MG}$ is the P50 confidence forecast date approved in the Main Gate business case and $P50_{C}$ is the project's current forecast or actual completion date as disclosed by the latest available NAO report data. In the case of projects predating 2000, that were approved without risk-based forecasts, the expected date approved at Main Gate is used in place of $P50_{MG}$, an approach that is consistent with explanatory notes presented in the NAO reports themselves.

Schedule risk differential consumed is calculated as:

$$\text{Risk Differential Consumed} = \frac{P50_{C} - P50_{MG}}{P90_{MG} - P50_{MG}}$$

$P90_{MG}$ is the P90 confidence forecast date approved in the Main Gate business case. The difference between a project's P90 and P50 forecast at Main Gate approval is referred to as being the risk differential.

Risk differential consumed is a measure used by the NAO in its annual MoD Major Projects Report. If a project is reported as having a risk differential consumed of 1.0, then its current P50 forecast is identical to the P90 forecast made at Main Gate. If confidence forecasts are realistic, and assuming that the effect of unknown unknowns is not significant, one would expect 10% of projects to have a risk differential consumed greater than or equal to 1.0 at completion. Similarly, one would expect 50% of projects to complete with a risk differential consumed of less than zero.

Why schedule performance is a good indicator of MoD risk management capability

In addition to monitoring projects' schedule performance, the NAO's annual MPR reports also monitor cost performance and the achievement of planned technical objectives, the latter being based on key user requirements (KURs). An explanation for the choice to focus only on the schedule dimension of project performance for the purposes of this paper is therefore required.

MOD equipment procurement projects have a relatively good record in respect of technical objectives, with the majority of projects achieving all KURs as planned at Main Gate approval. There is thus relatively little differentiation between the performance of projects from a technical perspective. It is cost and schedule outcomes that tend to be more variable.

In principle, trends in cost performance could have been analysed in the same way as those for schedule performance. However, many projects have been affected by scope changes that impact on cost baselines and thus compromise the usefulness of the analysis. Examples include:

- Reductions to the number of equipments (often masking cost increases)
- Changes to funding sources (transferring costs to or from a project's account)
- Incremental approval of additional equipments (which can mask cost increases or create difficulties with how to interpret the Main Gate baseline).

In practice, scope changes such as these affect so many projects that a cost performance trend analysis would be potentially misleading. In contrast, schedule performance is usually measured against a stable key milestone, typically the in-service date, based on the initial equipment deliveries tested to demonstrate compliance with the approved technical objectives.

It should also be noted that, on average, time risk on MoD equipment procurement projects has a greater impact than cost risk. For example, the NAO's 1999 MPR report noted an average project slip of 47 months, adding 38% to the duration of the average project lifecycle. Moreover there had been a trend of greater and increasing lateness with projects that had passed the main approval point. In comparison, average project cost escalation (excluding Typhoon) was running at 6.8%. This difference between schedule and cost variance may be attributable to MoD contracting strategy under which most post Main Gate projects are delivered by industry under fixed price contracts. Whilst this strategy transfers much of the cost risk to contractors, schedule risk affects all parties. Overall, schedule performance is thus the best measure with which to assess the MoD's ability to forecast and manage the implications of project risk.

Trends in Project Schedule Slip

Figure 1 shows the schedule slip reported for 32 of the 34 MPR projects that were post Main Gate approval during the NAO reporting years 2005-2010. The two missing projects are the development of the Joint Combat Aircraft, for which no schedule forecast was provided at Main Gate and Skynet 5, which was procured as a service using different lifecycle model. The projects are listed in order of their Main Gate approval date in order to identify schedule performance trends.

Project	Main Gate	Slip
Typhoon	Nov-87	41%
Brimstone	Mar-96	64%
Nimrod MRA4	Jul-96	141%
Astute	Mar-97	62%
ASTOR	Jun-99	51%
A400M	May-00	69%
BVRAAM	May-00	17%
Type 45	Jul-00	46%
Typhoon ASTA	Oct-00	27%
Tojan & Titan	Jan-01	21%
Bowman	Aug-01	0%
Support Vehicle	Nov-01	63%
NLAW	May-02	54%
Terrier	Jul-02	74%
CIP	Oct-02	124%
LF Anti-tank GW	Jan-03	-12%
Precision Guided Bomb	Jun-03	6%
Panther	Jul-03	25%
GMLRS	Aug-03	0%
Naval EHF/SHF Sat Coms	Aug-03	42%
Soothsayer	Aug-03	75%
C-Vehicle Capability	Dec-03	23%
MTADS/PNVS	Sep-04	8%
Watchkeeper	Jul-05	10%
Falcon	Mar-06	12%
Merlin Sustainment	Mar-06	0%
Future Lynx	Jun-06	0%
Advanced Jet Trainer	Aug-06	20%
Typhoon Future Capabilty	Jan-07	0%
Future Strat' Tanker Aircraft	May-07	0%
Queen Elizabeth Class	Jul-07	10%
UK MFS Increment C	Feb-08	65%

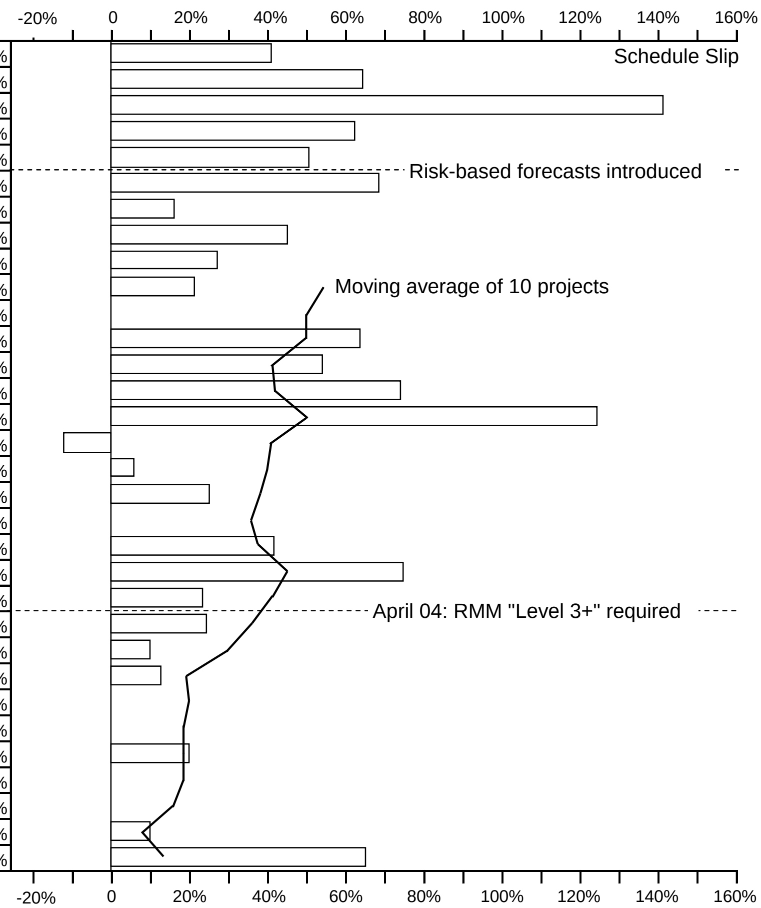

Figure 1 – Schedule performance of projects post Main Gate Approval

Figure 1 shows a clear trend of improvement in project schedule performance. The moving average of 10 projects starts at 56% and ends at 13%. There is some evidence that the introduction of risk-based forecasts in 2000 improved schedule performance, but there are a number of projects that are exceptions to this trend. The existence of such exceptions is consistent with the results of Project RMM assessments in the period April 2002 – March 2003 that showed that significant process improvements were required.

More convincing evidence of improvement is present in the performance of projects approved after April 2004 the date at which projects had to demonstrate a minimum level of risk management capability as a precondition for achieving Main Gate approval. The one exception to this trend is the UK Military Flying System (MFS) Increment C.

Trends in Project Schedule Risk Differential Consumed

Figure 2 shows the schedule slip reported for 26 of the 34 MPR projects that were post Main Gate approval during the NAO reporting years 2005-2010. The missing projects are the two also missing from Figure 1, the first five projects from Figure 1, that were approved prior to 2000 without risk-based forecasts (making it impossible to calculate risk differential consumed) and the Typhoon Future Capability programme, which, exceptionally, given its 2007 Main Gate approval date, did not have a risk-based forecast for schedule outcome.

Project	Main Gate	RDC
A400M	May-00	7.3
BVRAAM	May-00	2.1
Type 45	Jul-00	6.3
Typhoon ASTA	Oct-00	4.0
Tojan & Titan	Jan-01	0.9
Bowman	Aug-01	0.0
Support Vehicle	Nov-01	4.2
NLAW	May-02	3.6
Terrier	Jul-02	18.4
CIP	Oct-02	2.3
LF Anti-tank GW	Jan-03	-0.5
Precision Guided Bomb	Jun-03	0.5
Panther	Jul-03	0.8
GMLRS	Aug-03	0.0
Naval EHF/SHF Sat Coms	Aug-03	31.0
Soothsayer	Aug-03	5.0
C-Vehicle Capability	Dec-03	0.8
MTADS/PNVS	Sep-04	0.3
Watchkeeper	Jul-05	0.7
Falcon	Mar-06	0.7
Merlin Sustainment	Mar-06	0.0
Future Lynx	Jun-06	0.0
Advanced Jet Trainer	Aug-06	0.7
Future Strat' Tanker Aircraft	May-07	0.0
Queen Elizabeth Class	Jul-07	1.3
UK MFS Increment C	Feb-08	0.7

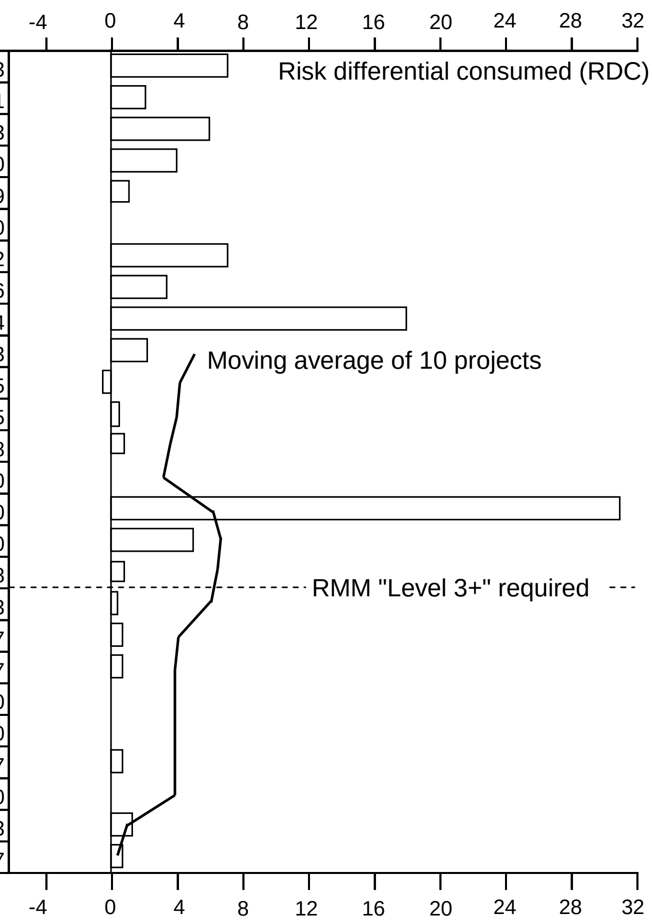

Figure 2 – Risk differential consumed for projects post Main Gate Approval

Figure 2 shows a trend in improvement. The moving average finishes at a value of 0.5. However, this trend does not become pronounced until the Naval Satellite Communications project approved in August 2003 drops out of the moving average. Whilst projects approved after April 2004 have consistently consumed low proportions of their risk differential, the performance of previously authorised projects has been much more variable and, on average worse.

The trend shown in Figure 2 suggests that projects subject to the discipline of having to demonstrate that they meet or exceed the Project RMM Level 3+ threshold at Main Gate developed more realistic schedule risk models as compared to their predecessors. The UK MFS Increment C project provides a useful example of this. Although Figure 1 shows that there has been significant schedule slip, Figure 2 shows that that the project has yet to exceed its schedule risk differential. The risk of significant slip was thus identified at Main Gate.

The 2010 NAO report discloses the cause of the UK HFS Increment C project slip to have been that negotiations for a Headquarters Building lease were delayed when the landlord opted to negotiate with a higher bidder. This is a risk of a type that is common in construction projects, but is singularly unusual in MoD equipment procurement. One is left with the impression that the risk analysis was conducted competently, but that the project approval decision might have been naïve.

In contrast, on the Naval Satellite Communications approved in 2003, it was the project's schedule analysis that was naïve. The risk differential for this project was only one month. In comparison, its slip post Main Gate was 31 months. However, it may be significant that its approval pre-dates April 2004, the date after which projects were required to demonstrate that their risk management process had sufficient capability to avoid naïve risk-based forecasts. Figure 2 shows that the period prior to April 2004 is characterised by big variations between projects in terms of their ability to forecast and manage risk effectively. This observation is consistent with the contemporary programme of Project RMM assessments that identified weaknesses with the models that had been used for cost and schedule risk analysis.

Discussion and Conclusions

The trends shown in Figures 1 and 2 suggest that the actions taken by the MoD to improve its project risk management capability have reduced risk on major projects. However, the most significant improvements would appear to have been gained by implementing a discipline that ensured that projects would produce more realistic risk models prior to Main Gate approval.

The importance of ensuring that the risk management process is effective prior to project approval is, perhaps, the key point to note from this paper. The author has often overheard views expressed to the effect that one cannot expect the risk management process to mature until the project itself has done so. Yet risk management is a response to lack of certainty; and uncertainty is at its greatest during the earliest phases of a project. These are the phases during which a risk management process can add the most value. In contrast, if a project becomes a bad project because it was approved with unrealistic objectives, the risk management process can only help to make the best of a bad job.

Another point arising from this paper is that it may take concerted effort and long time for a large organisation handling complex projects to make a significant transformation to its risk management capability. The MoD is accountable to the UK government and taxpayers for the effectiveness and efficiency of its project procurement process. When, in the 1990's it was faced with increasing evidence of project performance issues, it responded with a sustained programme of improvements to its risk management process. It aimed to achieve high standards for project risk management and created detailed internal process guidance for its project personnel. It also linked quantitative risk analysis to its system for the governance of projects and learned lessons from early evidence that forecasts produced by this analysis were too optimistic. It subsequently introduced the Project RMM as measurement tool to ensure that the intended process was implemented effectively. The overall period for process transformation was five years.

However, having made a significant effort to transform its risk management capability, the MOD can now demonstrate evidence of the benefits. Despite being inherently difficult and risky, the MoD's projects have always tended to meet their technical performance requirements more consistently than projects owned by many if not most other organisations. Since the year 2000, it has also been able to demonstrate an increasing ability to meet its project cost and schedule objectives.

Further information on the Project Risk Maturity Model book and CD-ROM can be found at www.rmcapability.com.

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About the Author

Martin Hopkinson

Author

Martin Hopkinson Martin Hopkinson is the Director and Lead Consultant at Risk Management Capability Limited. He has worked on projects in both the defence and civil sectors, including ship construction, IT services, space, the steel industry and railways infrastructure. These include three mega-projects on which Martin has led the risk management team. He has also provided consultancy advice in connection with a number of the largest projects undertaken in the UK.

Forming his own company has given Martin the freedom to help widen the understanding of improved approaches to project risk management. To this end, visitors to his web site can download free capability guidance sheets and other helpful resources at www.rmcapability.com.

Martin's book *The Project Risk Maturity Model* was published in January 2011. It includes a CD-ROM with working copy of the Risk Maturity Model software application that can be used by readers. Information about the book can be found at http://www.ashgate.com/default.aspx?page=637&calcTitle=1&isbn=9780566088797&lang=cy-GB.
He has also co-authored a number of books and guides produced by the Association for Project Management APM). These include the 2nd edition of the APM's *PRAM Guide* (2004), *Prioritising Project Risks* (2008), *Directing Change, a guide to governance of project management* (2004) and *Sponsoring Change, a guide to the governance aspects of project sponsorship* (2009).

Martin can be contacted at mhopkinson@rmcapability.com.